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JOHN W. FINCH, DIRECTOR

INFORMATION CIRCULAR

PLACER-MINING METHODS OF E. T. FISHER CO., ATLANTIC CITY, WYO.

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BY

CHARLES L. ROSS AND E. D. GARDNER

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PLACER-MINING METHODS OF E. T. FISHER CO., ATLANTIC CITY, WYO.[1]

By Charles L. Ross[2] and E. D. Gardner[3]

INTRODUCTION

A successful placer mine is being operated by the E. T. Fisher Co. on Rock Creek in the South Pass mining district at Atlantic City, Wyo. About 2,800 cubic yards of gravel is dug daily by a gasoline-driven dragline shovel with a 1 1/4-yard bucket and washed in a movable plant with a gold-dredge trommel and standard-dredge sluice boxes; the total cost is about 12 cents per cubic yard.

The gold-bearing gravel occupies a narrow valley between two low ranges of hills. The ground is covered by brush and willows, which are cleared off in the fall by burning after the leaves have dried. The elevation at the mine is 7,600 feet above sea level.

GEOLOGY

The channel ranges from 100 to 250 feet in width, the average being about 200 feet. The workable gold-bearing gravels extend along the creek for 14 miles. The proven depth of the gravel ranges from 9 to 12 feet; the average is 10 feet. The upper 3 feet of the deposit consists of barren loam, which is stripped and piled at the sides of the channel. The gravel is well-rounded and contains relatively few boulders. The screen oversize usually ranges up to the size of footballs. However, about a dozen boulders up to 18 inches in diameter are found each 8 hours of operation. Sixty-five percent of the material washed passes through the screen (minus 3/4 by 1-1/2 inches).

The gravel is easy-digging and free-washing. The bedrock, which has a slope of 2°, is diorite schist, of which the upper 2 to 5 feet has been decomposed into a tough, blue clay. Most of the gold occurs in the 6-inch stratum of gravel overlying the decomposed bedrock. The remaining gravel runs about 5 cents to the cubic yard. The gravel contains a relatively small amount of black sand - about a teasponnful of sand to the pan of gravel.

1/ The Bureau of Mines will welcome the reprinting of this paper, provided the following footnote acknowledgment is used; "Reprinted from U. S. Bureau of Mines Information Circular 6846."

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The gold is rounded and occurs in relatively small particles. Nuggets are rare. The largest found up to July 1934 was worth $105. This was caught in next to the last box under a section of the screen having 3/4- by 1-1/2 inch slots. A small part of the gold is rusty and does not readily amalgamate. The fineness of the gold ranges from 840 to 900; it contains 3 percent silver.

HISTORY

Gold was discovered in the district in the early days; a number of creeks were hydraulicked. Intermittent placer mining has been conducted in the district since then, mostly on a small scale until the present mine was begun. In June 1934 gold ore was being milled from one lode mine and development work was being conducted at three other underground properties in the district.

The grade of Rock Creek (2^{o}) is insufficient to permit the gravel to be flumed; hence, the deposit had not been hydraulicked, although a company built a 20-mile ditch and prepared to do so at one time. The gravel was too shallow and too limited in extent to justify putting in a floating dredge at the old price of gold. A few spots of the creek had been mined by hand, but the quantity of gravel washed in this manner is insignificant.

The ground was sampled by the present operators in the summer of 1932. The washing plant was designed and fabricated at Seattle. Stripping of overburden and the construction of the washing plant were begun on May 20, 1933. Washing was begun on June 15. Operations ceased for the winter on October 25 after 320,000 cubic yards of material had been handled; this quantity included stripping, bedrock drains, waste ditches, and other dead work.

Stripping for the 1934 season began March 27 and washing May 15. A total of 420,000 cubic yards was washed in 1934. The season closed October 17. A distance of 4,700 feet along the creek was washed in 1933 and a total of 11,200 feet up to the end of 1934.

SAMPLING

The deposit was sampled by driving pipes through the gravel. A single row of holes 150 to 300 feet apart was put down first along the center line of the channel. Rows of holes 1/2 mile apart were then drilled across the deposit; holes in the rows were 20 to 60 feet apart. The spacing depended upon surface indications. The holes extended through the decomposed bedrock to solid rock and averaged 14 feet in depth.

The sampling device was a 4-inch casing with a Keystone cutting shoe. The diameter of the shoe was slightly less than that of the pipe; the samples were retained in the pipe when it was withdrawn. The casings were driven down to refusal with a locally made pile driver. This consisted of a 275-pound hammer, a 20-foot, 4-legged, pole derrick, and a Chevrolet automobile engine and transmission shaft. The cable for raising the hammer ran through a sheave at the top of the derrick to a drum on the transmission shaft. The

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whole assembly was on a pair of skids and was moved forward by its own power; the end of the cable was attached to a deadman. The sampling outfit cost $300. to build.

The casings were pulled by means of a set of wire blocks having 4 and 5 sheaves. The cable from the blocks was wound on the drum by the engine. About half the time it was necessary to start the casing with jacks set against a clamp put around the top of the pipe. Three sets of casings were used. A pulled casing was laid on saw horses and the gravel removed in 6-inch sections by means of a special spoon; each section of gravel was panned.

The crew consisted of three men. The man in charge panned while the machine was being moved up and the next pipe driven. All three men pulled the casings. A total of 140 holes was put down in 2-1/2 months' time at a cost of $2,200, excluding traveling expenses. The cost per foot was $1.12. From 4 to 7 holes were driven daily when full time was spent in sampling. Four holes were lost because the pipe hit boulders. In these cases new holes were driven alongside.

After the sampling was completed the area was plotted, and the grade and amount of gravel were calculated. This was followed by sinking 46 shafts at average drillholes throughout the tract. These shafts were 4 by 6 feet and were sunk without timbering. The gravel from the shafts was washed in sluice boxes. Where the shafts were wet the water pumped from them while sinking was used in washing. Otherwise, sluicing was delayed until the shaft filled with water. A Larson, 2-inch high-speed, centrifugal pump, powered by a 1-1/2 hp. gasoline engine, was used to handle the water.

Two men sank a shaft each day while the third washed the gravel. The cost of sinking the shafts and washing the gravel was $1.50 to $4.00 per cubic yard of gravel.

The value of the gravel in the area tested, as calculated from the drill holes, averaged 19 cents per cubic yard (gold at $20.67 per ounce). The results of sluicing the gravel from the shafts indicated a value 15 percent higher (21.8 cents per yard). Actual recovery in washing has been very nearly 25 cents per cubic yard (42 cents at $35 per ounce). The discrepancy may be explained by the fact that in sampling all colors having a value of 1 cent or more were discarded.

WATER SUPPLY

The water supply is the natural flow of Rock Creek. About 50 miner's inches or 1-1/4 cubic feet per second is used in the plant. Up to July 1, 1934 no water was recirculated. However, due to the unusually dry season it was expected that part of the supply would have to be reused before fall.

The water is pumped through a line up to 1,200 feet in length of 12-inch, slip-joint, 14-gage pipe in 15-foot lengths at a pressure corresponding to a 50-foot head with a Byron Jackson centrifugal pump, direct-connected to a Climax 75 hp. gasoline engine. The engine required an average of 25 gallons of gasoline costing 20-1/2 cents per 8 hours.

The pump is picked up and moved by the dragline. Usually as the pump is reached it is moved upstream another 1,200 feet. Occasionally, however, it is picked up by the dragline and turned around on the same site and pipe added a length at a time until an advance of 1,200 feet is made. The dragline is then run down on top of the sand tailing to get the pump. A level place on which no overburden is deposited is left at each 1,200-foot interval. Less power is required when the pump is kept upstream from the plant.

A 48-foot length of pipe, held up by a truss guyed to the frame, extends at right angles from the washing plant. To this is attached 20 feet of hydraulic hose, which rests on a hinged apron from the end of the truss; one end of the apron rests on a berm at the original surface of the ground. A 90° elbow is attached permanently to the outer end of the hose. The elbow slips over the end of the pipe and is held in place by two chain tighteners permanently attached to the elbow. One end of the chain is placed around the pipe and the other end around the elbow and made fast.

DIGGING UNIT

The gravel is excavated with a power dragline with caterpillar traction, a 60-foot boom, and a 1 1/4-cubic yard bucket. A 1 3/4-cubic yard bucket came with the machine, but at the elevation of the mine the engine had insufficient power to handle the larger bucket. During the summer of 1934 a change was made from gasoline to 40-gravity fuel oil. More energy is generated with the new fuel, and future stripping will be done with the larger bucket. The gravel is dumped into the hopper of the washing plant 27 feet above level of the excavator. The shovel is oiled while the washing plant is being moved up.

The following tabulation gives the size and life of the cables on the dragline:

Cable	Diameter, inch	Length, feet	Life, days
Dragline	7/8	70	14 to 15
Hoisting line	7/8	134	25 to 35
Trip line	3/4	17	10 to 12

All cables are tru-lay. It takes an average of 5 minutes to replace a worn line. The 7/8-inch cable costs 35 cents per foot.

Bucket teeth last 2 to 4 days. After teeth are worn they are taken off and built up to size by welding on plow steel and a tip of stellite. Each tooth is treated twice in this manner before it is discarded. A new set of four teeth costs $20. Rebuilding costs $3 each, or $12 per set. A set of teeth can be replaced on the dipper in 10 minutes.

The shovel used about 25 gallons of gasoline, costing 20-1/2 cents per gallon per 24-hour shift. Forty-gravity fuel oil, which is to replace gasoline as a fuel for the shovel and the pump, costs 14-1/4 cents per gallon delivered. An average of 175 gallons of fuel oil and gasoline was used each 24 hours for all power purposes.

PLAN OF EXCAVATING

The creek was first diverted into a canal dug by the dragline at one side and 50 to 100 feet from the edge of the gravel channel. Stripping is done in two swaths. The shovel travels up one side and back the other. The machine can dig across a strip 180 feet wide without moving from side to side. As the gravel is stripped a drain ditch is dug 4 feet into the decomposed bedrock on either side of the tract to be worked. The overburden is piled in rows back of the drain ditches. The material dug from the ditches is piled on top of the gravel to be washed. On the creek side a berm is left next to the pit to hold the water pipe.

The stripping is kept a minimum of 50 feet ahead of the other work. Some stripping is done in the spring and fall when freezing weather prevents washing. During the spring of 1934 stripping was done 44 days before washing was begun. Until other operations catch up to the stripping (which will be about August 15), washing will be done on three shifts. Thereafter, stripping will be done on one shift (the midnight) and washing on the other two. Between 1,000 and 1,200 cubic yards of overburden (average, 1,150) is stripped per 8-hour shift.

The washing plant can handle the gravel as fast as the dragline can deliver it. The layout at Atlantic City is shown in figure 1. The washing plant is brought up near the center line of the pit. The distance to the creek side is kept constant on account of the water connections. Fifteen-foot cuts are taken across the channel. One cut is taken with the dragline set on one side of the line of the plant and the next with the excavator the same distance over on the other side. On the left side (looking downstream) a 40-foot jog is kept 15 feet ahead of the main face and on the right a 30-foot jog. This arrangement is a convenience in digging and saves moving the dragline twice for one cut. The washing machine is moved up 15 feet after each cut; this distance corresponds to the lengths in the water-supply pipelines. As the machine is moved up, one length of pipe is removed. Four moves are made each 24 hours. A move can be made in daylight in 35 minutes and after dark in 1 hour; the total time for 4 moves is 3 hours.

All digging is done dry. The bedrock is well-drained before it is taken up. When wet, it is sticky and hard to handle. From 18 inches to 2 feet of bedrock is washed. In digging, the bedrock material is mixed with the overlying gravel, which assist the washing. Large lumps of clay have a tendency to ball and pass through the trommel.

All work is done in an orderly and systematic manner. The overburden and screen oversize are piled in neat windrows. The sand tailings pile has the appearance of a wide highway.

During the 1934 season, up to July 1, 4 hours were lost while repairs were being made on the shovel and 3 days' time was lost pending delivery of parts for the water pump. The oil shaft on the pump broke on night shift, and the bearings burned out. No delays occurred on account of the washing plant.

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WASHING PLANT

The washing plant consists essentially of a receiving pocket, a trommel, a gasoline engine, boxes with dredge riffles, a belt stacker for handling the oversize, and a tailings sluice. It runs on a 15-foot sectional track made of 90-pound rails laid on 4-by 10-inch by 3-foot ties laid on 18-inch centers. The rails are 15 feet 7 inches apart.

An embankment 4 feet high and 5 feet wide on top is built with the draglines for supporting each rail. At the start these embankments were only 18 inches high, but this height did not allow enough elevation for efficient disposal of the tailings. Furthermore, complete drainage was difficult. The track is laid level both ways. A 15-foot straightedge and a spirit level are used in leveling. The plant is moved forward by the dragline used as a tractor. The washer weighs 55 tons.

Each side of the machine is supported by seven cast-steel double-flanged wheels 16 inches in diameter. Four wheels are on the back end and three on the front, with a space of 12 feet between each set. The distance between the front and back wheels is 42 feet center to center. The end wheels have a 6-inch face, the next an 8-inch, and the other 3 on **each side a 12-inch** face. The wider flanges of the center wheels permit turning the machine. Cast-iron wheels did not prove strong enough to support the load.

The hopper holds 3 bucketloads of gravel. Originally it was 6 by 7 by 11 feet, with a pyramid bottom; the size was cut to reduce the weight.

The trommel is 4 feet 6 inches in diameter; the screen surface is 12 feet long and the total length 22 feet. The rolls for turning the trommel run on the 5-foot blank space at either end. Beginning at the upper end there is 4 feet of 1/4-inch, then 4 feet of 1/2-inch holes. The lower 4 feet contain slots 3/4 by 1-1/2 inches long, which are made by drilling two 3/4 inch holes side by side. All holes are tapered to prevent blinding.

The trommel is turned at 14 r.p.m. The speed is adjustable, and when the feed has an unduly large proportion of clay the trommel is slowed. It is run by a 30-hp. Wisconsin engine that burns 10 gallons of gasoline per 8 hours. The trommel is built of manganese steel. No repairs had been necessary to July 1934.

The gold is saved in standard-dredge riffled sluices. Five 2-foot 4-inch boxes 12 feet long in parallel receive the screen undersize and discharge into a 72-foot tailings sluice 28 inches wide.

Riffles are 1-3/4 inches high, topped with 1/8-inch iron 1-3/8 inches wide and spaced 1-1/4 inches apart. They have a batter downstream, and the iron has an overhand of 1/8 inch. The same kind of riffles are used in the tailings sluice as in the inside boxes. The riffles are built in 1-foot sections. The boxes and tailings sluice are set on a grade of 19 inches to 12 feet (1-7/12 inches to the foot). No riffle repairs were necessary for the first season.

About 100 pounds of quicksilver is used in the riffles at a time. About 1/3 teacup is added to the boxes for each 400 cubic yards of gravel washed. The quicksilver loss for the 1933 season was about 30 pounds.

The stacker, consisting of a 26-inch rubber belt, is 40 feet long and set at right angles to the plant; the raise is 8 feet. It is run by the same engine that turns the trommel. It is considered that a stacker set at 45° with the line of advance and a correspondingly greater length would be an improvement, as it would permit better drainage back of the rock pile.

Whenever there is any delay in the feed to the washer the water is bypassed through a pipe on the stacker side of the machine.

TAILINGS DISPOSAL

As stated before, the oversize is piled by a belt stacker, and the sands are run out in a tailings sluice that discharges 8 feet above the bottom of the pit.

The sand tailings are directed by mud boards to the right (see fig. 1) in streams 7-1/2 feet wide at right angles to the line of advance. The boards are held by iron stakes driven into the tailings. As one course fills the boards are raised. Three sets of boards are used. The coarsest material settles near the point of discharge. The slime settles in a small basin at the right of the plant. A dike is made with the shovel after each cut from the track embankment to the side of the pit to keep the drainage water back. The fines spread out to the left until stopped by the rock pile. The water reaches the drainage ditch on the left by passing back of the washing plant. The ditch on the right is allowed to fill. The top of the tailings presents a smooth surface. One man works on the tailings dump continuously when the plant is running.

CLEANING UP

The inside boxes and the upper end of the tailings sluice are cleaned up every 10 days. Eighty percent of the hard amalgam is obtained in the upper 3 feet of the boxes. The lower end of the sluice is cleaned up every 20 days, mainly to open the riffles. During this period packed black sand about fills the space between the riffles.

In cleaning up, clear water is run through the boxes to wash off all light material. Beginning at the head of each box, each 1-foot section of riffles is taken up in turn. The hard amalgam, which is left behind as the other material is moved downward by the clear water, is scooped up. The live quicksilver, together with about 3 gallons of concentrate, is removed from each 12-foot box for further treatment. About eight 3-gallon buckets of material, including 3 from the tail sluice, are handled from each clean-up. Considerable black sand is washed over during the clean-up.

After cleaning up the riffles are replaced, new quicksilver is added, and the plant is started. About 2 1/2 hours is required for cleaning the boxes.

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The concentrate is treated first in a steel sluice with a puddling box at the head to separate out the live quicksilver. The material is stirred with whisk brooms to cause droplets of quicksilver to coalesce. Most of the black sand is run to waste. The riffle product from the steel box is treated in two batches in a 2- by 4-foot cylindrical amalgamation barrel that is turned 40 r.p.m. by a 1-1/2 hp. gasoline engine. Enough water to make a thic pulp and about 5 pounds of quicksilver are added to each batch, which is ground 35 minutes. Old cast-iron bucket teeth are used as grinding media. When there is any indication of grease in the concentrate a can of lye or a tablespoon of cyanide is placed in the barrel. The material from the clean-up barrel is run through the steel clean-up box again, and the amalgam and live quicksilver are recovered. The remaining black sands are run to waste. One man requires about 6 hours to treat the concentrate from one clean-up. The live quicksilver from both clean-up operations is strained through bags of 8-ounce canvas; it is then ready to reuse. The amalgam is squeezed by hand and retorted in a gold room at the office; the sponge gold is shipped to the mint. About 650 wet ounces of amalgam produces a brick worth $10,000.

CONSTRUCTION AND COST OF PLANT

As stated before, plans were drawn and the machinery for the washing pla fabricated at Seattle. The total equipment and supplies were shipped in three cars, the dragline in one, lumber in the second, and machinery and miscellaneous equipment in the third.

The screen posts of the plant are of 12- by 12-inch timber. Ten- by ten- eight- by ten-, and four- by six-inch timber was used elsewhere. In all a total of 30,000 board feet was required, including buildings.

The cost of the plant and equipment was as follows:

Dragling shovel, (used)	$14,000
Pumps	250
Engine for driving pump (secondhand)	750
Trommel	
Other equipment for washing plant	9,150
Timber	
Construction of plant, labor, and supplies	
Freight, Scattle to Rock Springs, Wyo.	2,300
Trucking, Rock Springs to Atlantic City, Wyo., 105 miles	750
	$27,200

The shovel was "walked in" from Rock Springs to Atlantic City on its o power in 12 days. The timber for the plant was framed on the ground. The plant was constructed in 13 days. Thirty days after the work was begun the first clean-up from 16,000 yards of gravel was made.

LABOR

Six men work on both day and afternoon shifts and five on night shift. The labor force for operating the plant on the three-shift basis is as follows:

Number	Classification	Rate	Totals
3	Shovel runners........................	$10.00	$30.00
3	Oiler (shovel) and general utility...	4.00	12.00
3	Screen attendants.....................	4.00	12.00
3	Tailings attendants...................	4.00	12.00
2	Trackmen [1]...........................	4.00	8.00
3	Bosses (members of firm)............		
17			$74.00

[1] The trackmen work on day and afternoon shifts only.

MINING COSTS

The daily cost at the plant is about $150, divided about equally between labor and supplies. Mining costs for 1934 are shown in tables 1 and 2. The cost of removing the overburden, including digging the ditches, was $0.05 per cubic yard. This expense is included in tables 1 and 2.

TABLE 1. - Operating costs, E. T. Fisher Co., 1934
(240 days worked; 420,000 cubic yards handled;
average value recovered, $0.2375)

Item	Amounts		Per cubic yard
Labor	$ 14,742.00		
Workmen's accident compensation	247.94		
Salaries (supervision)	3,725.00		
Oil and gasoline	7,805.13		
Other operating supplies	3,119.04		
Repair supplies [1]	6,666.85		
Freight and express	1,022.89		
General costs	410.00		
Telephone and telegrams	95.79		
Total direct		$ 37,834.64	$0.090
Taxes	874.34		
Rent	260.00		
Royalty	6,968.00		
Insurance	59.44		
Depreciation	3,097.70		
Total indirect		11,259.48	.029
Grand total		$ 49,094.12	.119

[1] Includes new bucket, stacker belt, and changing engine over from gasoline to oil-burning.

TABLE 2. - Summarized operating costs, E. T. Fisher Co., 1934

Item	Per cubic yard	
Labor	$ 0.036	
Fuel for power	.018	
Other operating supplies	.007	
Repair supplies	.016	
Supervision	.009	
Miscellaneous	.004	
Total direct		$ 0.090
Royalty	.017	
Depreciation	.008	
Others indirect	.003	
Total indirect		.029
Grand total		.119

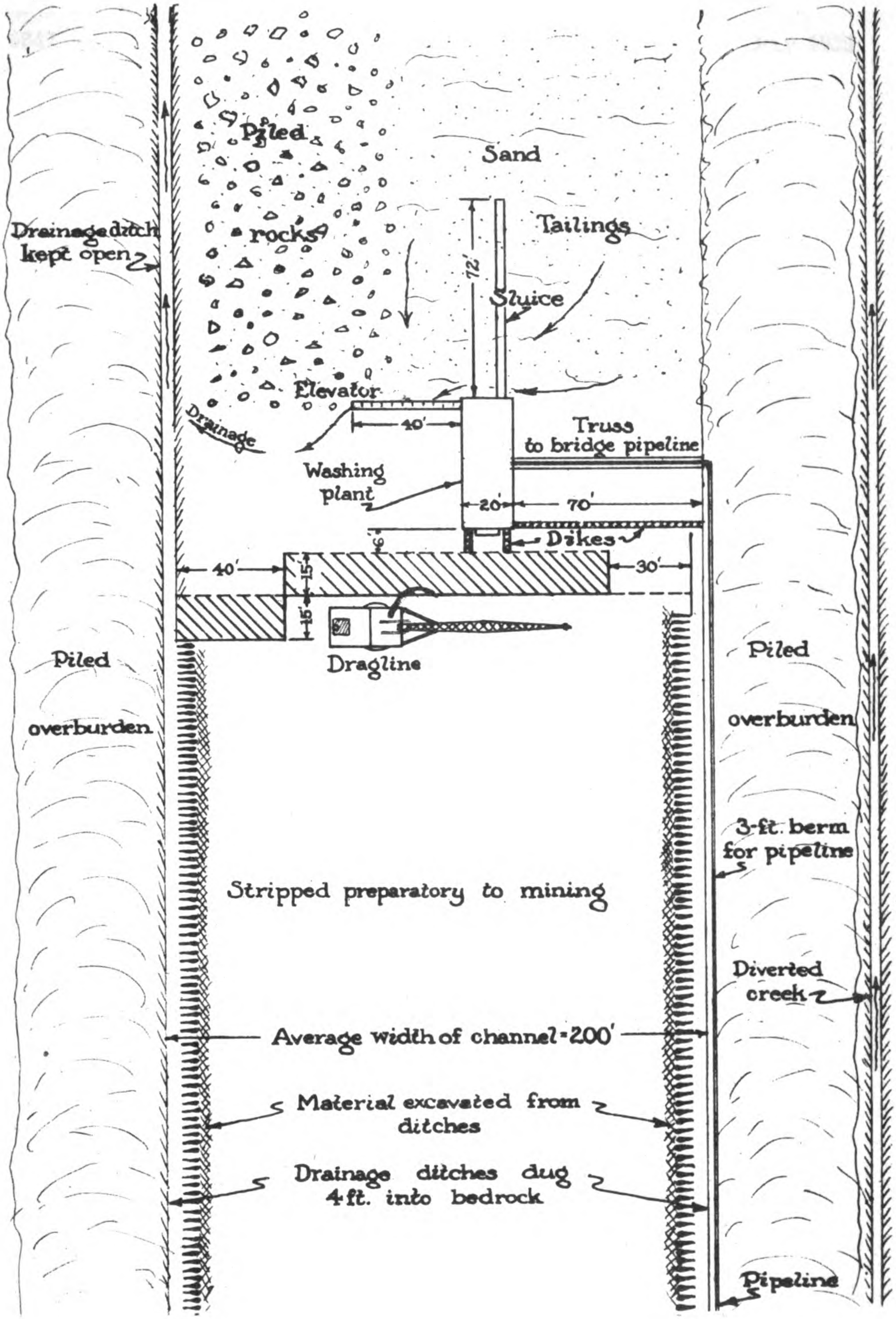

Figure 1.– Layout of E. T. Fisher Co. placer, Atlantic City, Wyo.